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LIGHT GUIDING FUSED SILICA CAPILLARY TUBING

Synthetic fused silica capillary tubing is widely used in the separation sciences, including the popular fields of Gas Chromatography, Capillary Liquid Chromatography, and Capillary Electrophoresis. From its advent in the late 1970's, steady advances in product quality have emerged. Light guiding fused silica capillary tubing is the latest step in this continuing development.

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INTRODUCTION

Improved purity of the synthetic fused silica, more durable external coatings, and tightening of specification tolerances are cornerstones in capillary tubing advancements. Researchers have successfully used capillary tubing filled with a high refractive index liquid to form an optical wave-guide. In one specific application, a low refractive index, external fluoropolymer coated capillary was employed in a Raman spectroscopy device(1). Although a viable product for light guiding applications, fluoropolymer coated capillary has never achieved the low cost or durability desired. A non-liquid filled light guiding capillary with a durable polyimide coating has been developed to fill this void.

EXPERIMENTAL DESIGN

The tubing preform consists of a standard high-OH silica tube over-clad with a layer of fluorine doped synthetic fused silica. The tube interior is not modified from the pure fused silica surface as on standard capillaries. This preform was then drawn using standard operating procedures into capillary tubing. A polyimide coating was applied, yielding products with dimensional specifications essentially identical to the corresponding standard capillary products.

RESULTS

It is clear from casual inspection that this capillary tubing embodies the light guiding properties of a fiber, yet retains its basic tubing design, internal surface chemistries and high strength. Figure 1 is an image of the end of a LTSP250350 light guiding capillary tube, being illuminated on its opposite end by a white light source.

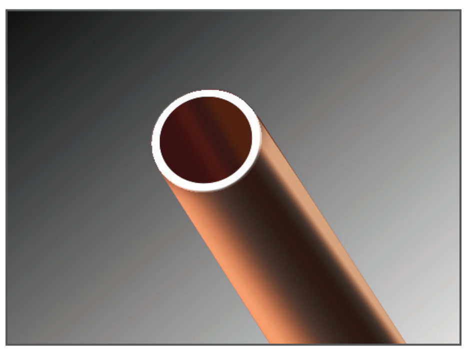

Figure 1: LTSP250350

Although additional testing continues, initial results indicate that attenuation (with an air filled interior) is similar to a standard high OH multimode step index optical fiber. Initial attenuation results indicate values of ~20dB/km at 500nm and values < 15dB/km at 800nm. Several sizes have been successfully produced, including ID/OD combinations (in µm) of: 50/150, 50/375, 75/200, 150/375, and 250/350. No glass surface chemistry differences have been seen and none are expected. Depending on the substance(s) introduced to the capillary interior the light guiding properties can be modified significantly.

CONCLUSIONS

Light guiding capillary offers a new horizon in capillary tubing applications, including:

- Unique sample detection and analysis.
- Increased path-length detection cells.
- Evanescent wave optics.

UV transmission inside of capillary allows for coaxial light-activated chemistries, curing of UV adhesives and detection of light producing reactions i.e. fluorescence.

Chromatographic columns with new frit technologies for improved durability.

This latest advance in tubing technologies should prove to bring exciting opportunities to both old new capillary techniques.

REFERENCES

(1) D. Che and S Liu, Long Capillary Waveguide Raman Cell, U.S. Pat. 5,604,587, 1997

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